



ANALYSIS OF MAINTENANCE RECORDS OF CONSTRUCTION EQUIPMENTS AND THEIR IMPORTANCE IN MINIMIZING EQUIPMENTS BREAKDOWN DURING PROJECT EXECUTION PHASE TO LESSEN TIME OVERRUN

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ABSTRACT

The capacity to win contracts and to perform them at a benefit is resolved for the development contractual worker by two key resources: individuals and hardware. While the investigation of human asset is its very own field it must be recognized that the machines are likewise similarly essential in accomplishing the objectives of the associations. To be monetarily focused, a temporary worker's hardware must be aggressive, both mechanically and innovatively. Gear upkeep and repair is one basic part of hardware administration that must be executed with extraordinary care in order to guarantee that the types of gear stay in the most ideal conditions to create the greatest. To make this conceivable it is basic that there is a very much composed administration data framework that furnishes with the required data to land at right hardware choices. Records are the fundamental reports of an administration data framework and in this way it is indispensable that they are fittingly outlined and put into utilization in the association to furnish with the essential data as and when required. In this review the hardware support and repair records and the upkeep of development ventures have been considered to know the modern practices regarding their significance.

Key words: Equipment Maintenance; Maintenance and Repair Records; Workshop; Replacement.

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1. INTRODUCTION

Substantial request with increment in many-sided quality of development, development plant and hardware has turned out to be fundamental piece of each venture. Development plant and gear contribute incredible arrangement towards speed, quality, wellbeing and proficiency of a venture. The motorization started to appear in the 1960's in development ventures. At first, government bodies, for example, Ministry of Surface Transport (MOST) and Public Works Department (PWD) imported types of gear and employed them out to temporary workers for execution of works. The market was likewise restricted in degree. In the 1980's, the tasks started to be progressively allowed on turnkey premise. Extend sizes likewise got to be distinctly bigger and outside subsidizing organizations began ordering the utilization of fitting supplies for works supported by them. Bit by bit, one of the criteria for pre-capability of contractual workers turned into the responsibility for. Speedier venture execution required best in class hardware. The normal unit cost of development hardware in the development works got to be around 15 to 20 percent.

India had just a couple development types of gear, in the pre-autonomy period. The types of gear were utilized without precedent for development in India in 1913 and it was a steam driven crane. Later supplies like draglines and scoops were utilized as a part of the development of Sind Barrage Canal System. A fuel tractor was utilized as a pulling unit in the year 1930-33. The main known responsibility for hardware by a contractual worker was in 1937. There were just 23 machines of aggregate estimation of Rs. 25.28 lakhs with Irrigation Department and temporary workers all over India. The requirement for development gear emerged after the Independence when major structural building activities were attempted for execution. Since there was no indigenous hardware fabricating industry in the nation, the required types of gear were foreign from abroad. The indigenous make of earthmoving types of gear began in India in the sixties and just a couple of types of gear were fabricated. The gross estimation of hardware utilized as a part of India likewise expanded since autonomy. In 1950, India had 95 machines esteemed at Rs.0.421 crores, in 1960 it had 934 machines esteemed at Rs.12 crores, in 1970 it went up to 643 machines esteemed Rs.21 crores and in 1979 it was 16048 machines esteemed Rs.297.5 crores. Of these 16048 machines, 1494 numbers esteemed at Rs.26.35 crores were possessed by privately owned businesses, 7134 machines esteemed Rs.132.73 crores were claimed by State Governments and the staying by the Central Government. Out of the aggregate supply of types of gear in 1979, 74 percent of hardware by esteem was foreign and these were generally excavators, tractors, dumpers, scrubbers, graders and loaders. Supplies like cranes, trains, belt transports, vibratory rollers, fork lifts and heap driving hardware were foreign made despite the fact that indigenous stock was close by. Some gear like unsettling autos, cableways, rocker scoops, ditchers and trenchers, black-top appropriation, paver finishers and spreaders were completely transported in. In this manner, the import part of development gear in India stayed high till 1979. Fast indigenization occurred from that point. The local creation of development gear came to about USD 1.9 billion in 2000, from the earlier year's yield of USD 1.6 billion. The growing development market is pushing up the creation of innovatively propelled hardware in India. Right now Indian firms fabricate a constrained scope of development gear. The items made

by them incorporate tractors, trucks, tippers, crawler tractors, crawler loaders, wheeled loaders, front-end loaders, excavators, raise dumpers, scrubbers, engine graders, water powered excavators, scoops, dozers, street rollers, fork lifts, solid bitumen blender, convenient and static compressors, versatile cranes, lifts, street pavers, compactors and pressure driven cranes. Significant development gear producing organizations are Bharat Earth Movers Limited (BEML), Heavy Engineering Corporation, Hindustan Motors (HM), Larsen and Toubro (L and T), Escorts JCB, Ingersoll Rand and so forth. Other noticeable producers of development gear in the mid section are Condequip, Alien Buildwell, Gujarat Apollo, Ashok Engineering, Leo Road Equipments, Jaypee and so forth. A considerable lot of these organizations have specialized cooperation with remote firms.

With the expansion in the span of tasks and furthermore time cutoff points being extremely stringent, substantial scale Mechanization appeared as it were. Directly, we can find in our nation settled and enormous development contracting firms owning substantial armadas of generally huge earthmoving and associated equipment's.

2. EQUIPMENT MAINTENANCE

Support of a bit of hardware is the operation of keeping its different segments in their unique frame beyond what many would consider possible with the view to guarantee that security and generation in operation don't weaken. It incorporates adjusting, examination and modification, little repairs in the field, real repairs and update in fundamental workshops and legitimate are of laid-up machine. The target of support would be to amplify accessibility of apparatus and offices required for smooth generation, limit downtime because of breakdown of apparatus, guarantee long existence of the apparatus to maintain a strategic distance from high rate of deterioration of capital and to gear support incorporates the accompanying sorts. Equipment maintenance are sorted into the following categories.

2.1. Break-down upkeep

This practice permits the machine to proceed in administration without a lot of routine consideration till it really separates. After repairs the machine gets consideration just when it separates once more. This practice is permitted just for those machines which are non-basic for creation.

2.2. Scheduled Support

This system is received to hinder the wear and tear of moving parts to get legitimate capacity of offices. This includes substitution of quick moving things, for example, fitters, seals, course, fan belts and periodical oil and so forth. It is found that around 70% to 80% of the upkeep will con under booked support and the adjust will be unscheduled. The upside of booked upkeep is that there will be least down time and required extra parts requested ahead of time. This practice assesses the time, materials and costs included, dole out the occupations to labor accessible.

2.3. Unscheduled Support

The unscheduled support is to be embraced because of a noteworthy imperfection found by the administrator which must be set right quickly or starting from the break and mishaps.

2.4. Preventive upkeep

Preventive gear support administration suggests a rational and formal program of arranged repair, part substitution, and adjusting exercises and the data administration framework encompassing them, all of which are actualized by an association to boost the accessibility of

hardware for operational assignments. Contrasted with having no upkeep program by any stretch of the imagination, the allocable hardware support expenses may increment, yet the estimation of enhanced gear profitability ought to be much more noteworthy. Keeping up gear efficiency is fundamental to a company's long haul benefit. This practice renders itself to precise arranging and booking which gives the accompanying advantages. Less creation down time and operation cost, fewer real repairs, reduced repair costs as less labor and fewer parts are requirement for arranged shutdown than for breakdowns. Preventive upkeep is the foundation of the whole support program. The support work is to be endowed to experienced faculty in such works.

2.5. Need for Equipment Records

Development is a definitive goal of an outline and machines make achievement of that goal conceivable. Motorized development is vital under specific conditions for brisk, productive and quality situated execution of the undertakings. The capacity to win contracts and to perform them at a benefit is resolved for the development temporary worker by two crucial resources: individuals and hardware. To be financially focused, a temporary worker's gear must be aggressive, both mechanically and innovatively. Advancing in the administration of a gear spread is basic for a contractual worker in accomplishing an aggressive valuing position. Keeping in mind the end goal to accomplish this, it is basic that there is set up a framework that gives the obliged information to settling on levelheaded hardware choices. Records are the fundamental reports that give these key information and along these lines it is basic to guarantee that records are outlined and set up to fill the need. Hardware and gear which have turned into a vital piece of any development movement and plants and apparatus now constitute a significant segment of the development cost in a venture (in order of 10 to 30 % of aggregate venture cost contingent on the degree of motorization), must be kept up to transform the venture into a benefit making community for any association. The Plant and Machinery (P&M) workshops on location are the spots wherein this support are completed and accordingly it is fundamental that the venture locales are furnished with a very much arranged and prepared P&M workshop.

3. METHODOLOGY

Development ventures (close Lucknow locale) executed by various organizations have been taken for the near review. Finish data about gear support, repair records upkeep and plant and apparatus workshop design has been acquired utilizing fundamental systems (talk with, survey, writing and past information accumulation). The consequences of the review will fill in as a kind of perspective for gear support and repairs record upkeep and furthermore hardware support and repair workshop layouts. This think about quickly examines the hypothetical hardware upkeep and repair records that are required to be kept up. The essential is to know the significance list for each repair and upkeep record by figuring relative significance list.

4. EQUIPMENT RECORDS

The fundamental data of the gear must be accessible and refreshed every now and again. Fundamental records of hardware are for the most part kept up in head office. The different data contained in the fundamental record are: Code number, Chassis/Serial number, Engine serial number, Auxiliary hardware serial number, Technical information of gear, Purchase information, Repair information, Work done, Fuel and oil utilization, Names of administrators and periods, Record of exchange to destinations, Complete record of gear

ought to be kept up in the accompanying archives: Daily/Monthly working information, Log Book, History Book, Maintenance records, Spare card.

4.1. Daily Working Data

For this reason the information is to be kept up as every day working hardware. Month to month extract ought to be set up for getting the month to month information regarding hardware utilized. It gives the accompanying data: About hour's hardware utilized on a specific employment, gear sit without moving time on specific day, gear breakdown hours and its causes, repairs completed on the hardware.

4.2. Monthly Working Data

This is the summary of the equipments monthly performance and gives details about the equipment's fuel and lube consumption and total equipment utilization. It gives the following information: Monthly availability and the actual utilization of the equipment, equipment's monthly fuel and lube consumption, equipment's actual monthly working hours, idle hours and breakdown hours, over all monthly repairs carried out on different equipments.

The data from this record provides with information on the utilization of the equipment that can be compared with the planned utilization to arrive at management decisions on further equipment utilization.

4.3. Log Book

This is the report kept up by the clients for everyday record keeping of hardware. It gives such subtle elements as administrators record, fuel devoured, Hrs used, yield points of interest, where used, name/mark of working client, time of breakdown and reasons, time of inaction and reasons et cetera. The log book likewise records the utilization of fills and greases. The log book ought to be given as much significance for legitimate support with respect to estimation book. It is the interface between the mechanical and client areas. It might likewise contain working and support guidelines. This is ordinarily kept up at site and not exchanged with the gear. The Log Book is to be used for the accompanying purposes: For a specialized control to assess how the machine is performing, getting the 'plant hours' execution characterized by works, decide execution, the aggregate plant hours put in by a machine must be known and reasons for "inconvenience" ought to be ordered. The different structures incorporated into the log book are day by day log sheet, hardware fuel utilization record, gear driver/administrator record.

4.4. Daily Log Sheet

The daily log sheet is the very basic record of equipments and is a part of the log book. In the daily log sheet the following information are entered: equipment and project detail, operator name, details of kilometer or hours run, fuel and lubricant consumed, detail of work done and sign of the in-charge.

4.5. Equipment Fuel Consumption Record

This record of the log book is used to record the fuel, oil and lubricants consumption of the equipment. These details can be used to determine the efficiency of the equipment and also the economical use of the equipment with respect to fuel, oil and lubricants consumption. The record gives information about equipment monthly runs and fuel consumption and average fuel consumption (KPL/LPH).

4.6. Equipment Driver / Operator Record

Operator's efficiency is one factor that influences the output of the equipment and therefore it is necessary that this record is maintained. This record gives information such as date on which the equipment was handed over to the operator, date of withdrawal and reasons for withdrawal of the equipment, total work performed by the operator and remark on the work performed.

4.7. History Books

This is the main record of mechanical section for each equipment. It is also an important record for the management. It is possible with records in history book to evaluate the general condition of a machine at any time, to decide the nature and extent of the next overhaul, to help in scaling the spare parts required in future and to assess its value. It remains in the mechanical section and is transferred from site to site with the equipment. History book normally contains the following types of information. Equipment details – Code, details of procurement, technical specification, capacities of fuel, oil, lubricants etc, transfer details, tyre fitment and tyre rotation details, repair and maintenance record, abstract of utilization of the equipment, abstract of fuel and oil consumption.

The various forms included in the history book are particulars of the equipment, equipment transfer record, record of daily operations, equipment repair and maintenance record, tyre replacement and rotation record.

4.8. Particulars of Equipment

This is a document of the history book that gives the general information about the equipment, such as type of equipment, make and identification code of the equipment, details of procurement, capacities of fuel, oil, lubricants etc, engine number, FIP number and other such useful information.

4.9. Equipment Transfer Records

It is typical of construction that various equipments are continuously transferred from one site to another and therefore it is necessary that proper record of the same is maintained. Equipment transfer record provide all details about the transfer and it contains information such as site from which the equipment is transferred and the site to which it is transferred, the date and time of equipment transfer, remark and sign of the releasing engineer with respect to its present condition.

4.10. Record of Daily Operations

This is that part of the record in which the record of all the activities with regard to the equipment for the day is registered. The various information are abstracted from the different records and entered into this. The information that are entered in this record are total hours worked or total kilometer run, down time, details of repairs carried out, details of fuel and lubricants consumed, operator name, nature of work and output, signature of operating in-charge and maintenance in-charge.

4.11. Equipment repair and Maintenance Record

This is that part of the history book in which the details of the various repairs and maintenance carried out on the equipment and the various materials used for such repairs and maintenance are recorded. The various information entered in this record are as follows date and name of mechanic, meter reading at which the repair or maintenance is being carried out,

details of the repair or periodical maintenance carried out, Part number, quantity, cost and indent number for the materials used, signature of the in-charge.

4.12. Tyre Replacement and Rotation Record

This that record of the history book in which the various information regarding the tyre replacement and rotation are recorded. The detailed information entered in this record are date on which the replacement or rotation is being carried out, tyre serial number, size and make, kilometer or hour run of the equipment at which the action is being carried out and tyre condition and cost.

4.13. Maintenance Records

Maintenance of a piece of equipment is the operation of keeping its various components in their original form as far as possible with a view to ensure that safety and production in operation do not deteriorate. The three principle aspects of maintenance are; servicing, repairs and inspection. Construction equipments, besides being expensive, has often to work under rough job conditions. Since the timely and economical completion of a work essentially depends upon a satisfactory performance of the equipment, the need for proper maintenance becomes important. Proper record keeping enables the obtaining of all information regarding equipment maintenance. The following maintenance records are generally maintained for most of the construction equipments, preventive maintenance record, special records for costly items.

4.14. Preventive Maintenance Records

Preventive maintenance as the name suggests, refers to the maintenance work undertaken a little before the possible or anticipated breakdown. Preventive maintenance involves systematic cleaning, inspection, lubrication, adjustments and repairs on a specified time schedule. Preventive maintenance is done to ensure optimum production by the equipment, extend the useful life of the equipment, ensure maintenance as per manufacturer's recommendation. The various records that are generally maintained to ensure effective preventive maintenance are instruction for daily maintenance, weekly maintenance record, monthly maintenance record, Quarterly maintenance record, half-yearly maintenance record, yearly maintenance record.

4.15. Special Records for Costly Items

Equipment is a costly affair wherein the repairs and replacement of equipment spare parts involves huge capital expenditure and therefore it is necessary to maintain the record of such expensive items. This record generally includes record for oil change and replacement of filter element, record for spare part replacement.

4.16. Equipment Legal Information

This is a document of the history book that gives the various legal information about the equipment. This information includes vehicle registration number, insurance validity period, RTO tax paid date and PUC validity period, fitness and permit validity period.

4.17. Equipment Accident Report

Due to legal requirements it becomes necessary to fulfill all the requirements of safety and execute all work in the project without accident. To ensure safety and healthy environment on the work site as well as to make economical use of the equipment it is essential. It gives information about the damage happened to the equipment and its present condition. It also

gives information about the cause of equipment's accident and injury / death of any person due to it, amount of compensation given to the victim, the total amount of damage to the equipment, remark on insurance claims, the date of completion of repair and the equipment deployed on work.

4.18. Spare Card

Spares form a very important item of repair expenditure. The range is very vast, price and quality variation is large and the past consumptions is the main basis for planning for future. If a proper record of spares consumption is maintained for each equipment then it would be possible to estimate the rate of demand for spare parts with a fair degree of accuracy. In view of above the following record should be kept for each item of spare: Item code, nomenclature, equipment type, make and model, details of receipt and issue, cost details, part number, interchangeability.

Spare card is one important document for the purpose of accounting of spares. It includes information about sources of spare part supplier, quantity of spare part available in store, minimum spare part stock required to be maintained to avoid stock out, details about the spare part issued for and information about spare part reordering level.

5. RESEARCH DESIGN

The survey research tactics has been espoused for this research. The target population consists of contractors, investors and technical staffs of real estate construction industries.

6. QUESTIONNAIRE OUTLINE

A questionnaire survey is progressed after analyzing 100 repairs and maintenance records of construction equipments to acquire the perspective and cognizance based on the relative importance index (in terms of importance) from the skilful respondents to ascertain expected consequences with the motive of narrowing the gap between the Indian construction equipment practices that currently prevail and the documentation of equipment records for reducing failure and breakdown during construction phase to lessen time overrun.

7. RESPONDENT BACKGROUND

The questionnaire was distributed among investors, contractors and project managers, 350 in gross, of real estate construction firms. Out of which, 275 responses were acquired consisting of 68, 125 and 82 responses from engineers, contractors and project managers respectively. All respondents had average working experience of ten years. Their responses were deployed for arranging various records in terms of their relative importance.

8. DATA ANALYSIS

The RII was computed by Chan and Kumaraswamy (2002) using the following formula:

$$RII_k^i(\%) = \frac{1 \times (n_1) + 2 \times (n_2) + 3 \times (n_3) + 4 \times (n_4) + 5 \times (n_5)}{5 \times (n_1 + n_2 + n_3 + n_4 + n_5)} \times 100$$

Where RII_k^i (%) is the Relative Importance Index of each factor. n_1 ; n_2 ; n_3 ; n_4 ; and n_5 are the numbers of each grouped respondents who selected: "1" representing very little effect; "2" representing little effect; "3" representing average effect; "4" representing high effect and "5" representing very high effect.

The data collected through questionnaires were analysed for relative importance index (RII) with regard to the perceived importance and implementation of Toyota Way sub-principles. Based on response taken through questionnaire from 275 respondents, the

response of effect for each delay factor were categorised as “very little”, “little”, “average”, “high” and “very high”. The scoring weightage for these effects were taken as 1, 2, 3, 4, and 5 respectively. Then using the formula of RII, the value of RII of each Toyota principle’s attributes is computed, which are given in table 2.

Table 1 Statistics showing equipment records relative importance

Equipment record	RII	Rank
Daily / Monthly working data	69.02	11
Log book	64.58	13
Daily log sheet	70.40	8
Equipment fuel consumption record	86.55	3
Equipment operator record	64.25	14
History books	69.27	10
Particulars of equipment	71.55	7
Equipment transfer record	73.84	6
Record of daily operation	88.54	2
Equipment repair and maintenance record	88.77	1
Tyre replacement and rotation record	81.36	4
Preventive maintenance record	80.12	5
Records for costly items	59.61	11
Equipment legal information	60.19	15
Equipment accident report	66.25	12
Spare card	69.77	9

9. FINDINGS

9.1. Description of Type 1 Organization

The organizations have two camps, Camp An and Camp B. Their fundamental workshop is situated in the focal camp B and has been considered for the similar review and has itemized association for the repair, upkeep and operation of types of gear. The general supervisor of the gear division reports to the occupant development director. The division has an appointee director who heads the operations, repair and upkeep of the plants and pavers and reports to the general chief. The operation, repair and upkeep of supplies are going by a senior specialist who reports to the general director of the division. The organizations have utilized a wide assortment of types of gear (crane, excavator, wheel loader, JCB, dozer, concrete paver, dumper, tipper trucks, solid blender, water tanks) and has distinctive sorts of records kept up to screen the support and repair exercises completed on hardware.

9.2. Description of Type 2 Organization

The organizations have an extremely incline association for the gear division (crawler and tractor dozers, dump trucks, bond fortifications, travel blenders, engine graders, pneumatic tyred rollers, etc.) because of the way that few sorts of hardware are kept up by it and the greater part of the supplies are under upkeep contracts. They have a yearly support contract (AMC) for supplies, for example, excavators, Volvo trucks and Tata trucks. Under the AMC get the providers of the types of gear and the association have gone to a comprehension by which the standard upkeep of the types of gear is done by the provider itself. The association has a concurrence with the provider of a couple sorts of types of gear wherein the provider might reclaim the hardware provided toward the culmination of the venture. The provider is in charge of the consistent repair and support of the hardware. The focal workshop (arranged at the focal point of venture) has been considered for the near review.

9.3. Comparative study of Equipment Maintenance and Repair Records

The data collected during the site visit were studied in comparisons with the literature available so as to identify the efficiencies and the deficiencies of the records maintained for equipment maintenance and repair. The outcomes of the analysis have been summarized in table 2.

Table 2 Comparative study

Data Type	Type 1 organization	Type 2 organization
Daily working data	A comprehensive daily log slips giving all required information is prepared.	Organization maintains a daily report giving all required information.
Monthly working data	It is not maintained on paper but the same is produced in suitable software.	It is not prepared.
Log sheet	Shows all information (available in the literature) with breakdown details.	It gives all required information.
Equipment fuel consumption record	An organization maintains monthly fuel consumption report. The fuel consumption calculated is per day and not per hour or per kilometer consumption.	An organization maintains only a daily record of fuel issued (not give any details of fuel consumption).
Equipment operator record	The details of operators name is entered in the daily record of operation.	It is not prepared.
History book	History book in the name of equipment log book is prepared by an organization.	An organization does not have it.
Particulars of equipment	Information as per the record found in the literature survey.	Details of available equipments are prepared(dimensions, purchase details and assembly information not covered).
Record of transfer	It does not contain details of the authority who releases the equipment from the site and where the equipment is transferred from.	The details of received from and sent to be maintained (no separate record).
Daily record of operations	Details of operation, repair and maintenance of equipment per day are maintained.	It is not maintained.
Equipment repair and maintenance cost	It has separate records for materials used during periodical maintenance and repair, preventive maintenance.(In the literature survey no such differentiation is seen and all are covered under the spare card itself).	A record for equipment repair and maintenance is not made and only the job card is maintained.
Record of tyres	A record of tyres is similar to the one found in the literature survey (cost details of the replacement tyres not covered).	No record of tyres is found.
Preventive maintenance records	Preventive maintenance records as per the manufacturer's and equipment requirement are prepared.	Same as case of Company X.
Instruction on daily maintenance	No separate record for the daily maintenance instruction but the same is given at the back side of the daily log slip.	No such record is found.
Record for oil change and	No separate recordbut is covered under the record of daily operations.	No separate record but is covered under the log sheet.

replacement of filter elements		
Record for spare part replacement	No separate record for spare part replacement (details of repair are recorded).	No record of spare part replacement. The details of spares used are entered in the job card.
Equipment legal information	No record of legal information of equipment at site and is maintained at the head office.	No separate record for legal information of equipment at site but the same is entered in the equipment details record.
Equipment accident record	Separate accident records are not maintained and any such details are covered as breakdown	Separate accident records are not maintained and are covered under the daily report from Central workshop.

10. ANALYSIS OF COMPARATIVE STUDY

The fuel cost contribution (Type 1) is on per day basis and not on per hour or per kilometer basis and therefore the accuracy of the result will be a matter of concern. The cost of per unit of work done, the cost of total repair and maintenance cost (Type 2) cannot be easily obtained from the available records as nowhere the quantum of work done is recorded. The data required for deciding the economic life of the equipments are available in the equipment log book of the type 1 organization. The records maintained by type-2 organization are not sufficient for economic life determination as complete information on output, cost etc. are not recorded. The increase or decrease in the fuel consumption of equipment cannot be obtained in both cases as the record provides the fuel consumption on daily basis rather than on per unit basis. The cost of spares used cannot be obtained in case of type-2 but it can be determined from the maintenance records of the type-1. The operating manpower requirement can be obtained from the various records of type-1 organization (detail of operator is available) and there is no record of the repair manpower requirement. Type-2 does not have any record required for estimating both operating and repair manpower requirements. The percentage utilization of the equipment (Type-1) can be calculated from the daily records of operation in which the details of the job, working hours, idle hours and breakdown hours are clearly mentioned. The percentage utilization of the equipment (Type-2) cannot be calculated from the various records and there is an absence in the recording output of work done by the equipments. Details of spares consumed over a period can be achieved from the details of spares (maintenance records of type-1) and thereby helping in planning for spares procurement. Details of spares are available in the job card only and though the information required for planning spares procurement can be had from this record it is a tedious procedure (Type-2).

11. PROPOSED IMPROVEMENTS IN EQUIPMENT MAINTENANCE AND REPAIR RECORDS

The type-1 organization has an efficient equipment management system and the use of information technology has only helped it in performing more efficiently. The record of fuel consumption has to be revised so as to provide the fuel consumption per hour or per kilometer and not per day consumption. The record of transfer should be revised so that the required details are filled by the authority who releases the equipment from the site. The record of tyres should be modified to include cost details of replacement. The record of legal information should be maintained at the site. A separate record of operators has to be maintained so that sufficient details about the operators can be entered in the record. For type-2 organization, minimum records are being maintained for the equipment maintenance and repairs. The available maintained records are insufficient to achieve the aim of record keeping. The system would do well if the following are implemented. Monthly working data

and history book has to be maintained as per standard format to provide useful data. Record of transfer of equipments must be maintained separately in the history book itself. Equipment fuel consumption record should be revised to provide information of per hour or per kilometer consumption of fuel. Equipment operator record with equipment breakdown record must be introduced. Instructions on daily maintenance must be provided to make daily maintenance a compulsory practice. Records of oil change, replacement of filter elements and spare part, record of tyres replacement and rotation must be introduced.

12. CONCLUSION

Appropriate support lessens sit out of gear time of men and machines because of breakdowns. Hardware in great condition lessens ineffectual time and the odds of event of deferrals. Land area, accessibility of space and the arrangement of hardware administration being taken after are the central point that influences the gear support and repair workshop. Repair and support reasoning is one zoning that can be taken up as a different research proposition. Repair and support costs increments with machine age. Along these lines, rather than applying variable rate, a normal can be computed. Along these lines a repair hold amid a machine's initial life is developed which is utilized to take care of the higher costs that are normal later. Endeavors ought to be taken to record the different elements that have been considered in the designs. To be financially focused, a temporary worker's hardware must be aggressive, both mechanically and innovatively.

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